International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)
ISSN(P): 2249-6890; ISSN(E): 2249-8001
Vol. 9, Issue 1, Feb 2019, 373-378

INVESTIGATION OF MECHANICAL & METALLURGICAL PROPERTIES OF HYBRID METAL MATRIX COMPOSITES

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ABSTRACT

The composite material expects a fundamental part in the aviation and vehicle applications in light of their remarkable structuring properties. Most of the experts have offered centrality to Aluminum Metal Matrix Composite (Al-MMC) in light of hardness and harsh nature of fortress segments like Nickel (Ni) and silicon carbide (Sic). In this paper an undertaking has been made to make and considers the mechanical properties of Al6061-Sic/Ni with different associations is made through mix tossing process. It is found that 10% of sic and 5% of Ni strongholds in Aluminum compound has the best extraordinary quality among different pieces. The hardness of Al6061-Sic/Ni is lessened with extending the dimension of nickel.

***KEYWORDS:** Al-MMC, Sic, Ni, Stir Casting Process & Mechanical Properties*

Received: Nov 25, 2018; **Accepted:** Dec 14, 2018; **Published:** Jan 14, 2019; **Paper Id.:** IJMPERDFEB201936

Original Article

INTRODUCTION

Aluminum is used for lightweight applications in view of its low thickness. Aluminum -based materials discover various applications in vehicle and avionics organizations. Among the diverse strongholds like SiC, Al2O3, AIN, B4C, Ni, Graphite used as a piece of MMCs, SiC is one of the low thickness bolster open in broad sums. In later past, due to astounding, modulus, wear assurance and shortcoming insurance AMMCs with SiC strongholds have commonly found their applications in flight, military, normal, manufacturing ventures, etc starting late the particular amassing strategies are open for Al arrange composites, among them, blend tossing is a champion among the best process in light of its ease, versatility, low taking care of cost and high creation rate. Thusly, Al arranges composites are fabricated through mix tossing process in a manner of speaking. M. Vamsi Krishna et al., Investigated the Mechanical Properties of Al6061-SiC and Al6061-SiC/Graphite hybrid composites. These composites were prepared using blend tossing method in which the proportion of help is changed from 5-15% in endeavors of 5wt%.

The microphotographs of the composites uncovered extremely uniform spread of the particles in composites with a get-together at few spots. The test densities apparently were lower than theoretical densities in the majority of the composites. The dispersed Graphite and SiC in Al6061 compound contributed to improving the adaptability of the composites. The assessing electron micrographs of the precedents demonstrated uniform dissipating of the fortification particles in the framework with no voids. Baradeswaran has done experimentation on Effect of Graphite Content on Tribological direct of Aluminum mix Graphite Composite. He broke down the

6061 Aluminum blend – Graphite composite with graphite molecule scatterings up to 20 % to see its capacity to go about as a self-lubing up material at an ideal component of graphite. The tests were done to review the Tribological lead of the composite material with fluctuating graphite content concerning wear rate, a coefficient of rubbing and the impacts of sliding pace and sliding parcel under dry sliding conditions have in like way been broke down. The 6061 aluminum composite showed its ability to act agreeably as a self-lubing up material under scarcest wear rate and co-productive of pounding at 5 Wt % and 15 Wt % graphite content autonomously.

T.V.Christy et al., Studied on the Microstructures of Al 6061/TiB2/12P. Al 6061 amalgam is commonly used for business applications in the transportation, improvement and near structuring adventures. Al-TiB2 composite is a metal system composite (MMC) that can be created using the in-situ salt-metal reaction. With TiB2 as the particulate development, the properties of Al 6061 blend can be uncommonly gained ground. An examination of the mechanical properties and the microstructure of Al 6061 blend with Al– TiB2 metal framework composite containing 12% by weight TiB2P made through the in-situ process were shown. A.R.K.Swamy et al. has inquired about on Effect of Particulate Reinforcements on the Mechanical Properties of Al6061-WC and Al6061-Gr MMCs. It displays the comparative examination of the mechanical properties of Al6061-Tungsten carbide composites containing Tungsten carbide (WC) particulate, and Al6061-graphite particulate composites containing graphite particles. The sustaining particulates in the MMCs move from 0% to 4% by weight. The 'vortex strategy' of age was used to fabricate the composites, in which the strongholds were filled the vortex made by blending the fluid metal by strategies for a mechanical instigator. The composites so conveyed were exposed to a movement of tests. The results of this examination revealed that as the Tungsten carbide atom content was extended, there were gigantic augmentations in a complete versatility, hardness and Young's modulus, joined by a decline in its adaptability. There was, in any case, only an uncommonly insignificant addition in the compressive quality, whereas in graphite sustained composites as the graphite content was extended, there was an immense diminishment in hardness and monotonic augmentations in the pliability, extraordinary versatility (UTS), compressive quality and Young's modulus of the composite.

MATERIALS AND METHODS

Al6061 compound was used as the rough materials. The blend association of the Al6061 compound is Al-1Mg-0.6Si-0.5Fe-0.25Cu-0.20Cr-0.15Zn-0.1Mn (wt %). The SiC (5% to 15%) and Ni (4% to 6%) used as fortresses in the present work. The methodology of Al6061 composite was finished by condensing Al6061 ingot pieces in a delicate steel cauldron, before softening the pot in the radiator it is secured with Graphite stick which goes about as a debonding expert and contradicts the scattering of iron from the pot into liquid Al061. After the metal is completely broken up, the contamination show in the material is emptied. While condensing Al6061 an extensive proportion of separated gasses will be accessible in the fluid metal. The degassing methodology is wiped out in the tossing strategy. By discarding the degassing strategy, we can enhance the porosity of the last tossed thing. A frame is secured with graphite stick for the basic departure of tossing. After that fluid metal is poured fit as a fiddle at a temperature of 850°C. Subsequent to solidifying, the aluminum billet is ousted from the frame and made the particular association of weight rates of strongholds.

MICROSTRUCTURE CHARACTERIZATION

The Optical microscopy was utilized to think about the impact of the SiC and Ni on the microstructures of the Al MMCs. The specimens for the microstructure perception were set up by the regular mechanical pounding, for carving Kellar's reagent [HF + HCl + HNO3 + 95% H2O] is utilized and the Etching time is 10-30 sec

PROPERTY EVALUATION

The malleable property of the examples of Aluminum MMC bar was resolved as per ASTM: B 557:2006 principles. The pliable properties were measured by widespread testing machine demonstrate: UTN-40N. The estimations of extreme rigidity and level of prolongation were computed in view of the normal of 1 - 3 tests. The hardness test was measured Brinell hardness number.

RESULTS AND DISCUSSION

Microstructure

The accompanying figures demonstrate the microstructures of the diverse creations through the optical magnifying lens with 10µm grain measure as per ASTM E112. The microstructure plainly shows genuinely uniform dissemination of fortification with negligible porosity in the lattice combination. The conveyance of support inside the lattice is homogenous and thusly holding with fortification and network is peerless.

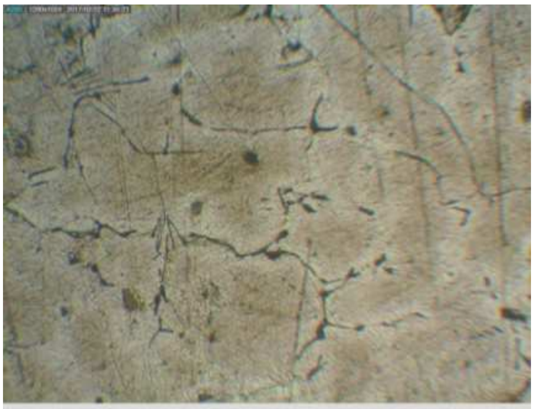

Figure 1: Al6061+5%Sic+4%Ni

Figure 2: Al6061+10%Sic+5%Ni

Figure 3: Al6061+15%Sic+6%Ni

BRINELL HARDNESS TEST

The small-scale hardness test was performed on AL 6061 base combination and silicon carbide, nickel composites by applying a heap of 250kg. The test was completed at three unique areas so as to repudiate the conceivable impact of indenter laying on the harder particles. The breadth of the indenter is discovered utilizing basic magnifying lens. The normal of all the three readings were taken as the hardness of test. Brinell hardness number for Al6061 and created

composites are arranged. The formula is used to calculate the Brinell hardness number, Where p=load=100kgf, Ball diameter (D)= 2 mm

Intention diameter (d)

$$BHN = \frac{2P}{\pi D\left(D - \sqrt{(D^2 - d^2)}\right)}$$

Table 1: Experimental Results for Brinell Hardness Number

S. No	Composition	Observed Values in BHN			
		Impression 1	Impression 2	Impression 3	Average
1	Al6061+5%sic+4%ni	59.0	60.6	58.4	59.33
2	Al6061+10%sic+5%ni	51.0	54.8	52.8	52.87
3	Al6061+15%sic+6%ni	51.9	53.8	55.8	53.83

Figure 4: Al6061+5%Sic+4%Ni

Figure 5: Al6061+10%Sic+5%Ni

Figure 6: Al6061+15%Sic+6%Ni

TENSILE STRENGTH

Tractable test was performed on Al6061 composites. These pieces are machined according to ASTM B 557:2006 gauges. The pliable test is completed by applying the pivotal load at an explicit augmentation rate to a standard ductile example with realized measurements till failure.

Table 2: Experimental Results for Tensile Strength and % of Elongation

S. No	Composition	Ultimate Load (KN)	Tensile Strength (N/mm^2)	% of Elongation
1	Al6061+5%sic+4%ni	12.56	100.73	3.4
2	Al6061+10%sic+5%ni	13.92	107.33	3.44
3	Al6061+15%sic+6%ni	10.76	90.55	3.5

Table 2 demonstrates the variety of the elasticity dimensions of Al6061 ace combination and its structure with composites. The chart demonstrates the expansion in elasticity with increment in support in the composite and figure 8 demonstrates the disappointment examples in the wake of directing the rigidity.

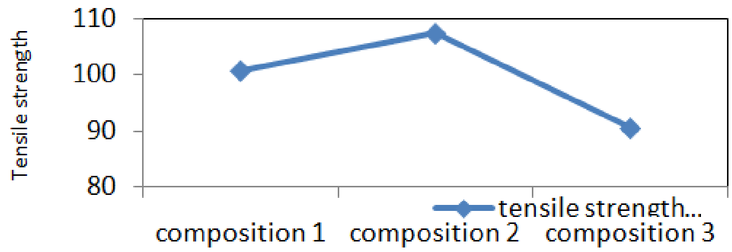

Figure 7: Graph between Tensile Strength and Al6061-Sic/ Ni

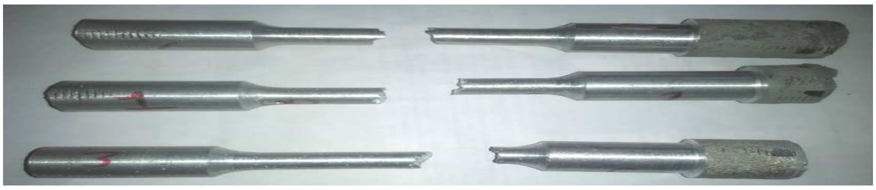

Figure 8: Specimen after Tensile Test

CONCLUSIONS

In perspective of the exploratory results, it tends to be assumed that an extension in the dimension of SiC and Ni strongholds in Aluminum amalgam develops an authoritative unbending nature to a certain rate. The microstructure considers revealed that the truly uniform scattering of the particles in Al6061-SiC/Ni composites and hardness decreases with the addition in wt % of the Nickel.

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